Note 6A • Entering and Editing Matrices

Entering a Matrix

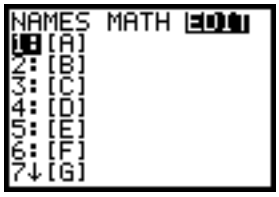
To enter a matrix, follow these steps:

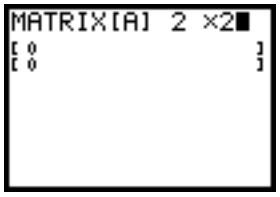
a. Press 2nd [MATRX] and from the EDIT submenu select a matrix.

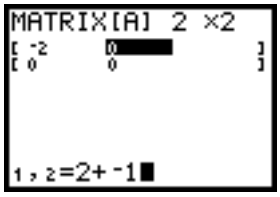
b. Enter the dimensions of the matrix (rows and then columns).

c. Enter a value into each cell. Press ENTER to register each entry and to move the cursor to the next position. You can use fractions and operations when you enter values.

d. When you finish entering values, press 2nd [QUIT] to return to the Home screen.







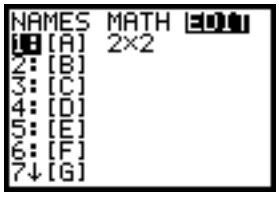
Editing a Matrix

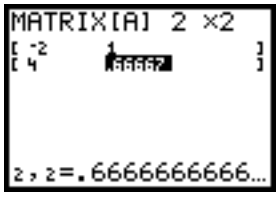
To edit a matrix, follow these steps:

a. Press 2nd [MATRX] and from the EDIT submenu select the matrix you want to edit.

b. Arrow to the cell you want to change. Enter the new value and press ENTER. You can also change the dimensions of a matrix. Notice that when you create a new row or column the values in the cells begin as zeros.

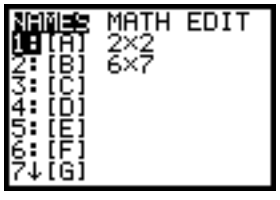
c. When you finish editing values, press 2nd [QUIT] to return to the Home screen.

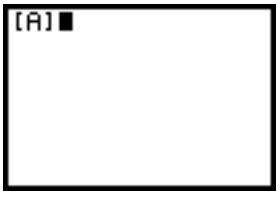


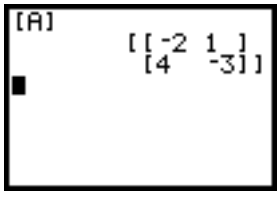


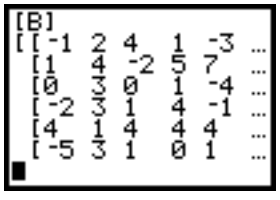
Viewing a Matrix on the Home Screen

To view a matrix on the Home screen, press 2nd [MATRX] and from the NAMES submenu select the name of the matrix. Press ENTER to display the matrix. If the matrix is too large to fit on the screen, use the arrow keys to scroll across or down the matrix.



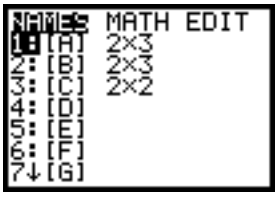


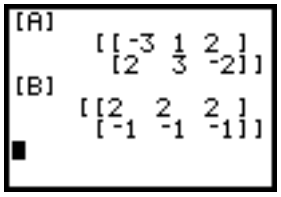


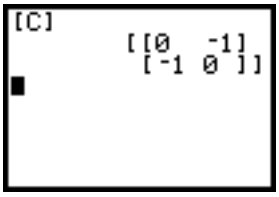


Note 6B • Matrix Operations

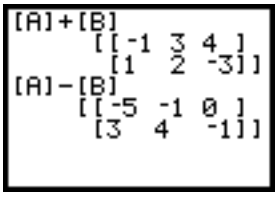
You can perform operations with matrices just as with numbers. The following examples use matrices [*A*], [*B*], and [*C*].



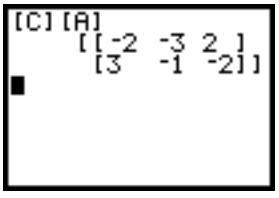




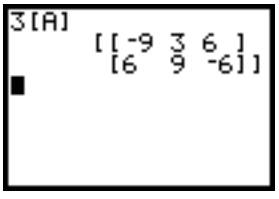
You can add or subtract matrices if they have the same dimensions.



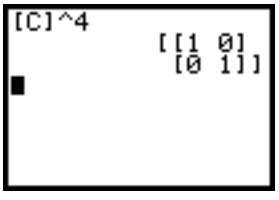
You can multiply two matrices if the number of columns in the first matrix matches the number of rows in the second matrix.



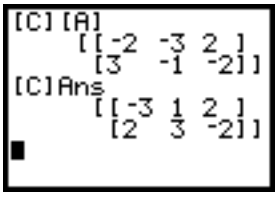
You can multiply any matrix by a constant.

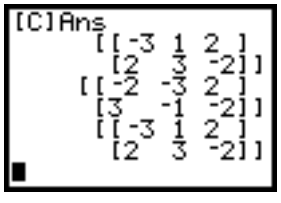


You can raise a square matrix to a power.



The result of a matrix operation can be stored into a matrix or used in the next calculation. This way you can work recursively with matrices.





(continued)

Errors

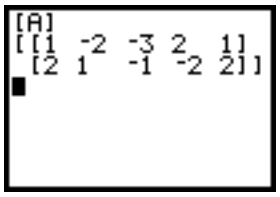
If you get an ERR:DIM MISMATCH message, then the dimensions of the matrices do not satisfy the operation's criteria.

An ERR:UNDEFINED message probably indicates that you have named a matrix that is not defined.

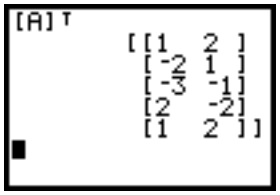
Note 6C • Plotting a Polygon

You cannot plot a polygon directly from a matrix, but you can convert a matrix into lists and plot a polygon from the lists.

For example, the matrix $\begin{bmatrix} 1 & -2 & -3 & 2 & 1 \\ 2 & 1 & -1 & -2 & 2 \end{bmatrix}$ represents the quadrilateral with vertices (1, 2), (−2, 1), (−3, −1), and (2, −2).



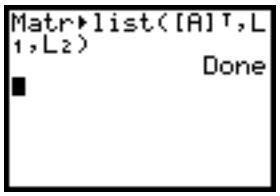
(To graph a closed figure, the first point must be repeated as the last point.) You can convert the matrix columns into lists by selecting 2nd [MATRX] MATH 8:Matr>list(. However, to plot a polygon, the matrix rows need to be converted into lists of x- and y-coordinates. To switch the rows for columns of your matrix, press 2nd [MATRX] MATH 2:T. This matrix is the *transpose* of the original matrix.

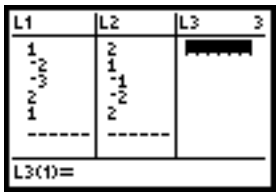


So, to plot the polygon represented by a matrix, follow these steps:

a. Enter the matrix and store it as matrix [A].

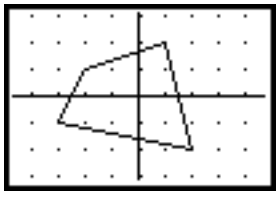
b. To store the coordinates as lists, enter 2nd [MATRX] MATH 8:Matr>list(2nd [MATRX] NAMES 1:[A] 2nd [MATRX] MATH 2:T , 2nd [L1] , 2nd [L2]) ENTER.





c. Set up Plot1 as an xyline plot with list L1 as the Xlist and list L2 as the Ylist.

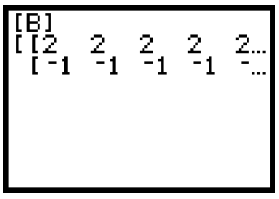
d. Set an appropriate window and display the graph.

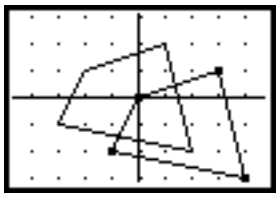


[−4.7, 4.7, 1, −3.1, 3.1, 1]

(continued)

You can also use matrices to transform polygons.



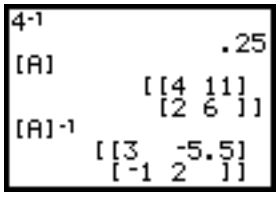


[−4.7, 4.7, 1, −3.1, 3.1, 1]

Note 6D • Inverse Matrices

To find the inverse of a matrix, enter the name of the matrix and press [x⁻¹].

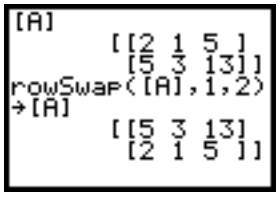
If you get an ERR:INVALID DIM message, the matrix is not square; if you get an ERR:SINGULAR MAT message, one row of the matrix is a multiple of another row. In either case, the matrix has no inverse.



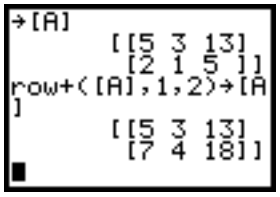
Note 6E • Matrix Row Operations

The calculator can perform four operations on the rows of a matrix.

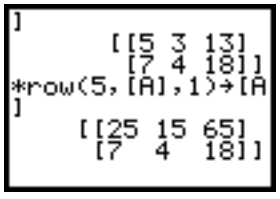
To exchange two rows in one matrix, use [2nd] [MATRX] MATH C:rowSwap. For example, you exchange rows 1 and 2 of matrix [A] with the command rowSwap([A],1,2).



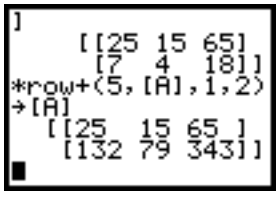
To add the entries of one row to those of another row, use [2nd] [MATRX] MATHD:row+(. For example, you add the entries of row 1 to those of row 2 and store them into row 2 with the command row+([A],1,2).



To multiply the entries of one row by a value, use [2nd] [MATRX] MATH E:*row(. For example, you multiply the entries of row 1 by 5 and store them into row 1 with the command *row(5,[A],1).



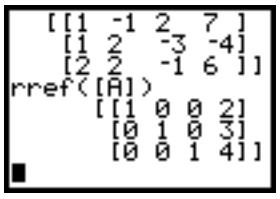
To multiply the entries of one row by a value and add the products to another row, use [2nd] [MATRX] MATH F:*row+(. For example, you multiply the entries of row 1 by 5, add the products to row 2, and store them into row 2 with the command *row+(5,[A],1,2).



These commands don't change matrix [A]; they create a new matrix. You'll probably want to end each command by storing the new matrix with a new name or by replacing [*A*] with the new matrix, as was done in each of the examples.

Note 6F • Reduced Row-Echelon Form

To convert an augmented matrix to reduced row-echelon form, enter 2nd [MATRX] MATH B:rref(and the name of the matrix.



This example shows solving the system

$$\begin{cases} x - y + 2x = 7 \\ x + 2y - 3z = -4 \\ 2x + 2y - z = 6 \end{cases}$$

to get $x = 2$, $y = 3$, and $z = 4$.

Note 6G/App • Graphing Inequalities with the Inequal App

To start the application, press APPS and select **Inequal**. Go to the Y= screen.

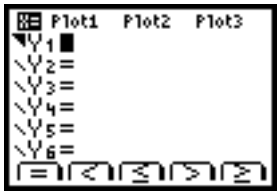
a. Move the cursor over the = symbol.

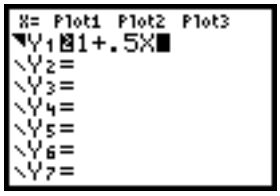
b. Press ALPHA and one of the five top-row keys, [F1] to [F5], to select the type of inequality you want to graph.

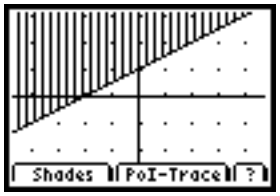
c. Arrow to the right of the inequality symbol and enter the rest of the inequality.

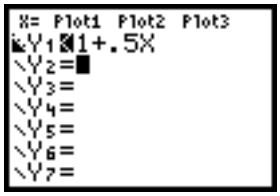
d. Set an appropriate window. For **ShadeRes=** enter an integer from 3 to 8 to adjust the space between the shading lines. The larger the number, the larger the space.

e. Press GRAPH to display the graph of the inequality. Notice that the boundary line of a strict inequality, $<$ and $>$, is represented with a dashed line.

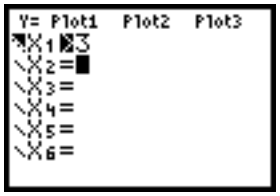


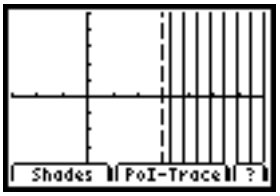






To graph an inequality with a vertical boundary line, arrow to X= in the upper-left corner of the Y= screen, press ENTER, and proceed as if on the Y= screen.





To turn off the application, press APPS, select **Inequal**, and choose **2:Quit Inequal**.

(continued)

Graphing Systems of Inequalities

a. Enter the system of inequalities, set up the window, and press GRAPH.

b. To find the intersection of the regions, press ALPHA and one of the keys under **Shades**, [F1] or [F2]. Then select **1:Ineq Intersection**.

c. To find the points of the intersection of the boundary lines, press ALPHA and one of the keys under **PoI-Trace**: [F3] or [F4]. Use the left and right arrow keys to move to a point on the same line and the up and down arrow keys to move to a point on a different line.

These screens show how to graph the region defined by the system

$$\begin{cases} y \le 6 - x \\ y \le 5 \\ x \le 4 \\ y \ge 0 \\ x \ge 0 \end{cases}$$

The last screen shows the intersection of the two boundary lines Y1 and Y2.